visible hemisphere, was from May 24 to August 27, 1888, and the next longest succession of almost spotless days occurred during the autumn of 1886. In the month of January the solar disturbances consisted of small round spots of the normal type, but for the rest of the year small groups were more common than isolated spots, the principal member of the group being almost invariably followed by a number of lesser companions. In general, the spots did not last long, being for the most part very shallow disturbances.

Watching the general surface on days when the definition is unusually perfect, there does not seem to be much change from year to year, nor is there even a very marked difference between the appearance at a maximum and at a minimum period. The veiled spots continue to show themselves with great persistency in every portion of the surface, and the character and rapidity of their changes appear to be unaffected by the causes that produce the variations in the solar cycle. The sub-permanent veiled-spots, seen only within the spot-zones, have not been recorded more than twice or thrice during the last twelve months; but the slight penumbral markings, which start as ill-defined dots, and, quickly spreading out, congregate in considerable numbers so as to form large blurred patches, have often been seen most distinctly. The darkness of the shade in these markings is sometimes much more intense than usual, and not unfrequently these darker-veiled spots are observed in large numbers in the neighbourhood of scattered faculæ.

An observation of some importance was made on the day preceding the closing day of the year, and which I may perhaps be allowed here to recall, as it seems to indicate the commencement of a fresh solar cycle. The observation was the record of a small group of spots in the high latitude of 36° S, whereas spots have of late been confined within a rather narrow equatorial zone. If this group proves to be the forerunner of other spots similarly situated, we have fair grounds for concluding that a continual decrease in the mean spot-area, until the end of the present year, will be followed in 1890 by a rapid increase in the number and extent of solar disturbances.

Stonyhurst Observatory:
1889, *January* 9.

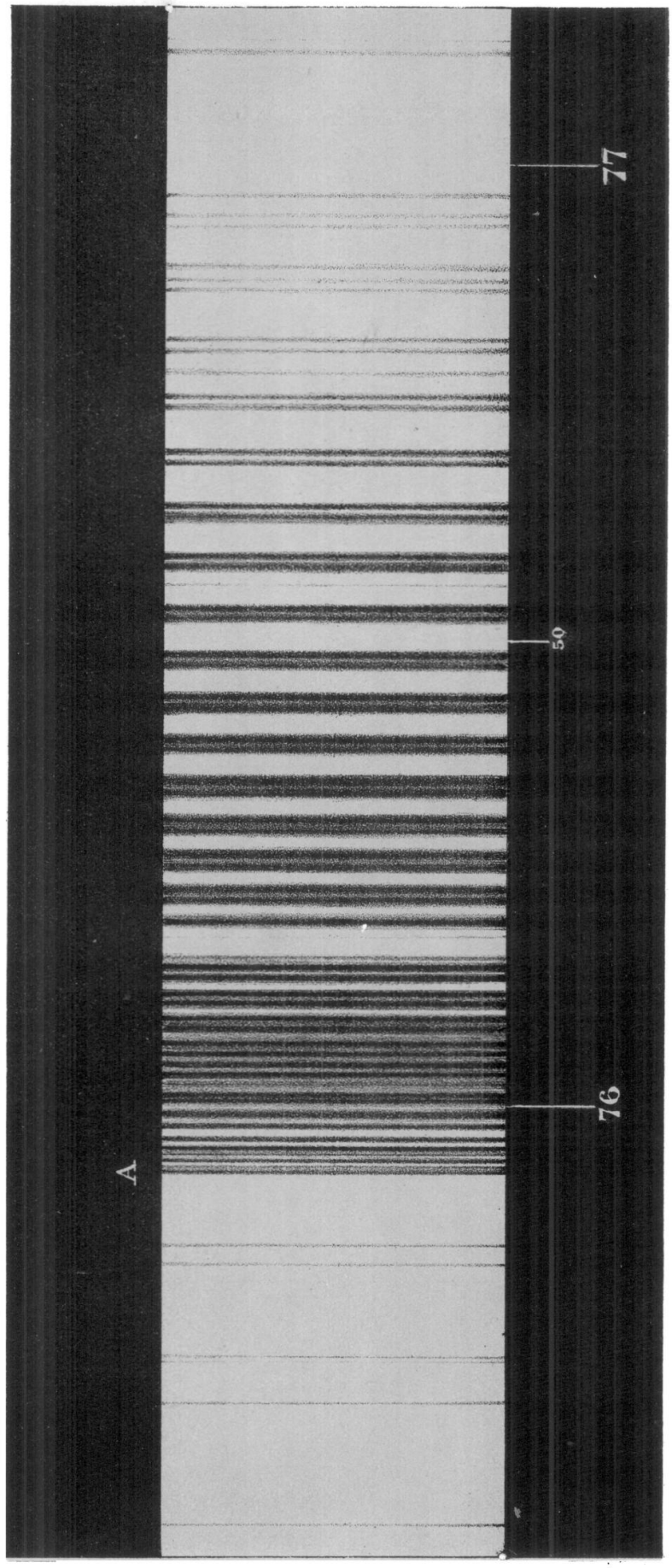
Photographs of the Red End of the Solar Spectrum from the Line (D) to the Line (A) in Seven Sections. Taken by F. McClean, M.A., F.R.A.S.

The accompanying photographs represent the red end of the solar spectrum from Fraunhofer line (D) to Fraunhofer line (A).

They comprise just one half of the visible spectrum from the line (H) to the line (A).

Dr. Rowland's published photographs of the solar spectrum

THE A GROUP of the SOLAR SPECTRUM.



Photographed by F. Mc. Clean.

W.H. Wesley lith. West, Newman & Co imp.

(excluding the ultra-violet spectrum beyond the line H) comprise the portion of the spectrum between wave-lengths 3,900 and 5,800 tenth metres (10^{-10} metres). The present photographs comprise from wave-length 5,800 (above D) to wave-length 7,700 (below A), or just as much again.

The sections, numbered from VII. to XIII., into which the photographs are divided, correspond to the sections of Ångström's normal solar spectrum—counting from the section containing (H) towards the red.

The scale of Section VII. (containing the line D) is the same as the same section of Ångström's Chart, but from this onwards the scale increases slightly along with the corresponding increase of the dispersion of the spectroscope employed. The spectroscope employed consists of a Rutherford Grating, ruled 17,296 lines to the inch, and about $1\frac{3}{4}$ inch square. The grating rotates, and the telescopes are fixed. The dispersion, therefore, increases as the secant of the angle of displacement of the grating from its central position. The increase in the scale of the photographs is about one-tenth from (D) to (A).

The red spectrum photographed is that of the second order. But besides the principal photographs of the sections of this spectrum, subsidiary photographs are given, showing, in the same sections, both the red spectrum of the second order as before, and also the overlapping, green to violet, spectrum of the third order. These double spectra were taken successively through the upper and lower portions of the same slit, and they serve as tests of the freedom of the red spectrum from the overlapping third order spectrum.

The positions of the leading divisions of the scale of wave-lengths are taken from Ångström's Chart. From (D) to (C) the scale is placed directly on the second order spectrum, while from (C) to (A) the scale is first applied to the subsidiary third order spectrum, and that of the second order spectrum obtained from it. Since the wave-lengths, at common points of the overlapping spectra, are strictly in the ratio of 3 to 2, these double spectra thus furnish an accurate scale to the obscurer parts of the red spectrum.

The present photographs are enlarged about $8\frac{1}{2}$ times from the original negatives. It must be remembered that the photographs of the green to violet portion of the third order spectrum, included in the subsidiary photographs, are not given as finished photographs of that portion of the spectrum. They are only given for the special purposes explained above. Their definition has, so far, suffered in the endeavour to obtain the two overlapping spectra on the same photograph. Also, the object-glasses at present employed in the spectroscope fail in bringing to a definite focus the image of the spectrum situated above the line G.

The principal photographs also need improvement in many respects, and they are only put forward in their present state

because they form, substantially, complete photographs of the red end of the solar spectrum such as have not hitherto been produced.

This paper is illustrated by a very faithful drawing by Mr. Wesley of the A group of lines, taken from the photographs. The photographs themselves have been placed in the Library.

1888, *December* 13.

Note on Observations of Nebulæ Spectra at Hurstside Observatory.

By Albert Taylor.

The observations of nebulæ spectra recorded in this paper have been made at Sir Henry Thompson's Observatory (recently erected at Hurstside, West Molesey, Surrey) with a 12-inch refractor by Cooke, and a new star spectroscope by Hilger, specially adapted for observations of spectra of faint stars and nebulæ. The dispersive apparatus consists of a train of one 60° prism and two half-prisms, the half-prisms being attached to the lenses of the collimator and observing-telescope of the spectroscope. The micrometer is constructed so that one turn of the screw moves the cross-wires $\frac{1}{100}$th of an inch, and the drum being divided into 100 parts, readings can be made with accuracy to $\frac{1}{10000}$th of an inch, and by estimation to a smaller fraction than that.

The cross-wires of the micrometer can be illuminated at will by means of a small electric lamp. The eyepiece usually used for measurements has a power of 15, but a power of 10 was used for the nebula in *Lyra*.

The nebulæ examined were the Great Nebulæ in *Orion* and *Andromeda* and the Ring Nebula in *Lyra*.

The Great Nebula in Orion.

The spectrum of this nebula has been observed on every possible occasion during the last four months of 1888, and the results, while fully confirming Dr. Copeland's 'Observations' at Dun Echt, communicated to the Society in June 1888, also add several other lines which have not previously been recorded.

Previous to Dr. Copeland's observations, the visible spectrum of the Great Nebula was usually given as consisting of four bright lines and a faint continuous spectrum, the wave-lengths of the lines being given as 500, 495, 486, and 434. To these Dr. Copeland added 5874 (D_3), the position of which he had obtained from no less than 33 measurements, and a brightening at 447·6, seen only on one occasion. He found the continuous spectrum extending from 568 to 459·5, and showing "some indications of resolvability into lines or bands."

In September 1888, although the nebula was badly placed for observation, and daybreak interfered, measurements were made at